

# THE WEATHER AND CIRCULATION OF DECEMBER 1962

## Record Cold in the South

L. P. STARK

Extended Forecast Branch, U.S. Weather Bureau, Washington, D.C.

### 1. WEATHER SYNOPSIS

Wintry weather came before mid-December this year to most States east of the Rockies. An historic cold wave during the second week was almost as severe as the memorable one of February 1899. Many cities reported new daily, monthly, or all-time low temperatures from the Plains eastward. At the same time western States averaged warmer than normal although zero temperatures reached New Mexico, Arizona, and the Great Basin at one time or another during December.

Near blizzard conditions occurred over the Plains, the Lakes, and the east coast, and resulted in record December snowfall in several cities. In contrast snowfall was extremely light over the West where deficient soil moisture and the light snow pack were causes for concern.

### 2. MONTHLY MEAN FEATURES

#### CIRCULATION

Low zonal index characterized the 700-mb. circulation during December 1962 (fig. 1) over the Pacific, North America, and the Atlantic. In these regions from 5° W.-175° E. between latitudes 35° and 55° N. the index was 8.8 m.p.s., a value that was 2.6 m.p.s. lower than normal. In contrast throughout most of Asia, the index was relatively high.

Over the Pacific positive height anomalies formed an arc from the west through the Bering Sea and across Alaska while negative heights covered a broad area in the central Pacific from 20° to 50° N. Associated with this arrangement of height anomalies was a familiar split in the westerlies (fig. 2), one branch of which went north of Alaska and the other far south to near 35° N., more than 5° latitude farther south than normal. These aspects of the flow represented a major readjustment in the broad-scale circulation from December. This is shown in figure 3, the anomalous height change from November to December. Widespread height rises in northerly latitudes and height falls in the central Pacific reflect the shift of cyclonic activity southward and anti-cyclonic activity northward as the zonal regime of November (fig. 1 of [1]) was replaced by strong blocking in December.

In North America the average circulation was strongly meridional and was directly related to events in both the Pacific and the Atlantic. It is seen in figure 1 that the pattern of height anomalies in the Atlantic was similar to those in the Pacific except that the former were displaced farther southward. The principal effect of the Atlantic blocking complex was to magnify the meridional nature of the flow in eastern North America. Thus the relatively warm air off the east coast northward from 35° N. and the cold air transported into the trough from Canada provided a mean baroclinic zone to help maintain the trough.

Almost everywhere in Europe and Asia 700-mb. heights were lower than normal with significant departures of 470 ft. in northern Siberia and 240 ft. in the Balkans (fig. 1). The cold northerly anomalous component from Spitzbergen to North Africa was associated with strong blocking in the Atlantic, and was accompanied by repeated surges of cold air into lower latitudes. (Gross features of this flow are analogous to those in North America.) Thus there were ingredients for frequent cyclogenesis near the warm Mediterranean Sea. These storms assisted in the maintenance of the vigorous trough that extended from North Africa through Russia to northern Siberia.

#### TEMPERATURE

Quite low temperatures in the eastern half of the United States this month (fig. 4) ranged to 8° F. below normal in the Ohio Valley and from 2°-4° F. lower than normal along coastal areas of the Gulf of Mexico and the Atlantic.

At the 700-mb. level (fig. 1) the pattern was ideal for repeated injections of cold air into the East. Associated with Pacific blocking, the ridge in western North America was maintained in sufficient strength to account for northerly anomalous flow into the Southeast where below normal heights were observed. This relationship between above normal heights in western North America and below normal heights (and cold weather) in the Southeast in the cold season, though not inevitable, has a high probability of occurrence.

The severe cold wave of the second week (see sec. 3) was responsible for all-time minimum temperatures in many cities in the South and Southeast and has been



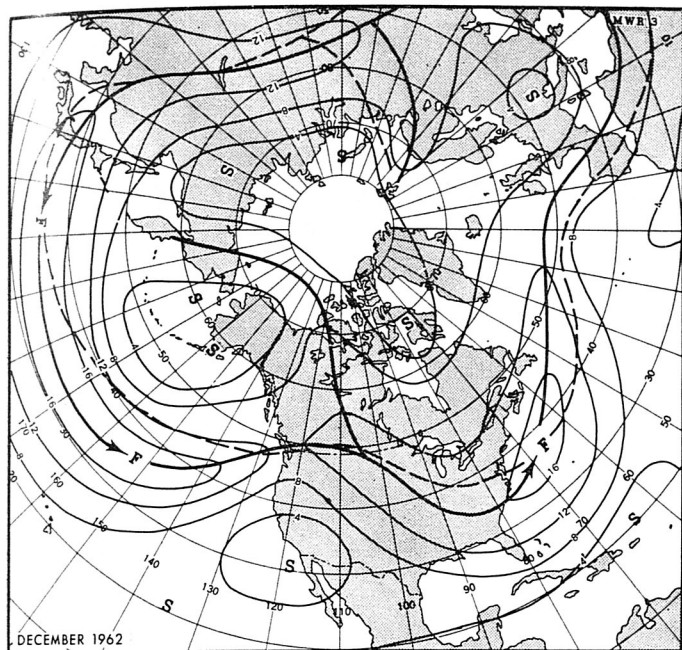


FIGURE 2.—Mean 700-mb. isotachs for December 1962. Heavy solid arrows show primary axes of mean maximum winds, and dashed lines the normal December position.

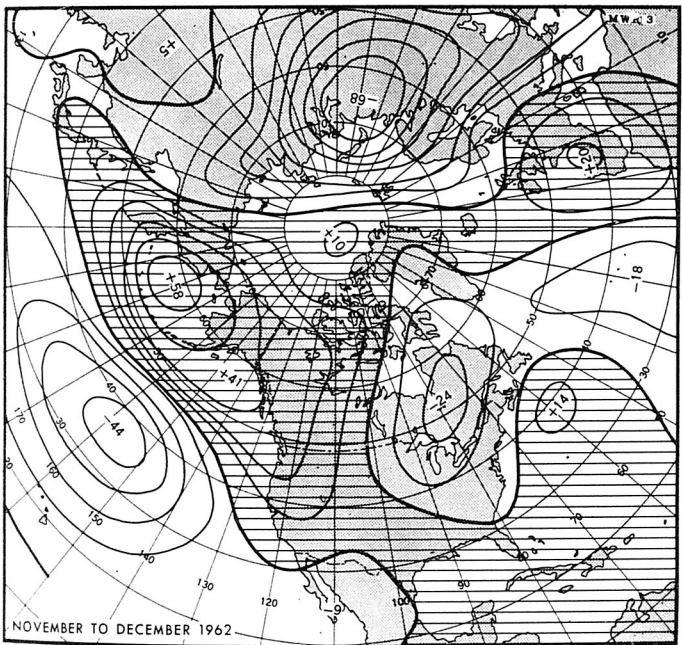


FIGURE 3.—Mean 700-mb. height anomaly change from November to December 1962. Spread of blocking to the Pacific is indicated by large rises at high latitudes and falls at lower latitudes.

averaged  $1^{\circ}$  F. below normal for the month and at Honolulu International Airport the lowest temperature of all time ( $54^{\circ}$  F.) was recorded on the 20th.

This month's distribution of average temperature (fig. 4)

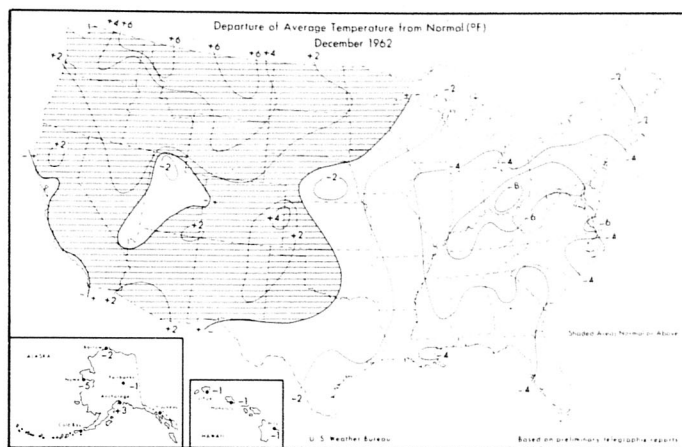


FIGURE 4.—Departure of average temperature from normal ( $^{\circ}$  F.) for December 1962 (from [5]). Meridional pattern was typical of amplified 700-mb. flow.

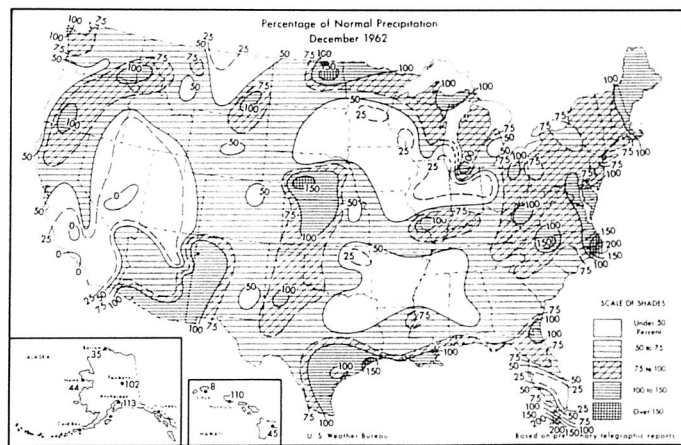


FIGURE 5.—Percentage of normal precipitation for December 1962 (from [5]).

was a continuation of a pattern that started in early autumn. Persistence of temperature anomalies from November to December usually averages about 67 percent [3]. Considering 100 cities in the United States and five temperature anomaly categories (much above, above, etc.), it was found that this year only 10 cities cooled or warmed by more than one category from the preceding month, so the persistence of 90 percent in December 1962 was indeed high.

#### PRECIPITATION

Total precipitation in December (fig. 5) was generally near normal over a large portion of the eastern United States with the exception of those areas in the Mississippi Valley that were rather dry.

Less than normal precipitation over much of the West accompanied above normal temperatures. Low precipi-



TABLE 1.—Monthly snowfall records established in December 1962

City	Observed snowfall (in.)	Average snowfall (in.)
Muskegon, Mich.	54.2	16.6
South Bend, Ind.	41.9	13.8
Cleveland, Ohio	30.3	10.9
Youngstown, Ohio	22.4	11.8
Washington, D.C.	*16.2	3.1

\*Exceeded annual average.

tation was also favored by anticyclonic curvature and a northerly direction of the anomalous component of the 700-mb. flow.

Excessive snowfall was deposited by vigorous storms that followed one of three tracks this month (see Chart IX of [2]). Cyclones out of Alberta produced snow mainly in the Lakes region; cyclogenesis along the east coast was responsible for snowstorms from the Middle Atlantic States northward; and two disturbances that came out of the southwestern trough brought snow to the Plains, the Lakes, and along the east coast. These storms were associated with the broad cyclonic upper-level flow and released sufficient snow to account for new records at those cities listed in table 1.

### 3. WEEKLY WEATHER AND CIRCULATION

#### FIRST WEEK—BLOCKING

Blocking in eastern North America (figs. 6A and 6B) was the principal circulation feature the first week. This low index state is indicated by 700-mb. heights that were below normal over the eastern half of the Nation and greater than normal over the West and across Canada. The circulation was in transition from the rather high index of late November when the zonal westerlies were more than 3 m.p.s. higher than normal; by the end of the first week the index was about 3 m.p.s. lower than normal.

Temperatures over the Nation (fig. 6C) were also in transition and responded quickly to the circulation change. During this week a change to colder was noted everywhere east of the Divide except in New England where some temperature increases were noted. Temperatures in excess of 20° F. higher than normal in the upper Mississippi Valley preceded the first cold outbreak of December. Averages for the week, however, indicated below normal temperatures only in the southeastern quarter with the freezing line extending well into central Florida.

Heavy snowstorms in the Lakes region accompanied a deepening Low that was associated with upper-level blocking. Cleveland, Ohio, had 15.6 in. of snow in 3 days, its heaviest snowfall in 8 years; snow also fell as far south as central Georgia where amounts were light.

#### SECOND WEEK—RECORD COLD WAVE

Intense meridional components from the sub-Arctic to the sub-Tropics describe the average 700-mb. circula-

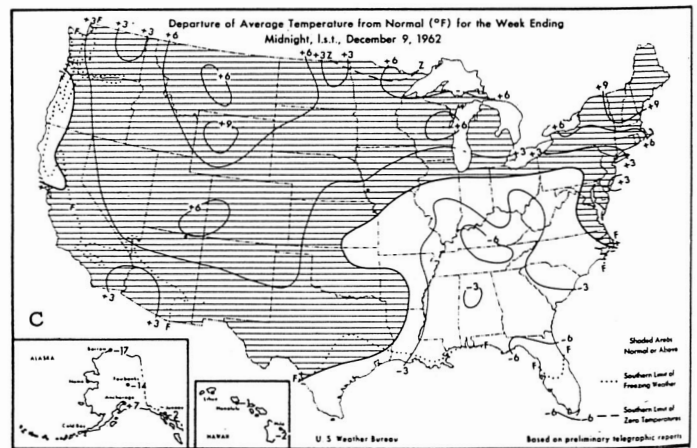
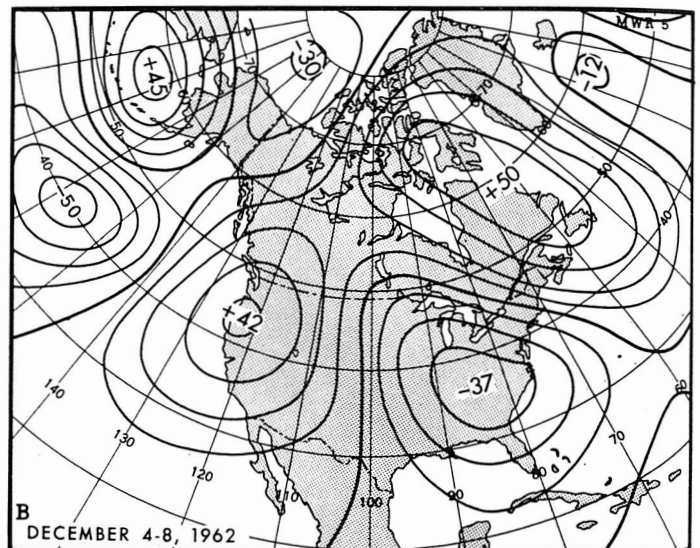
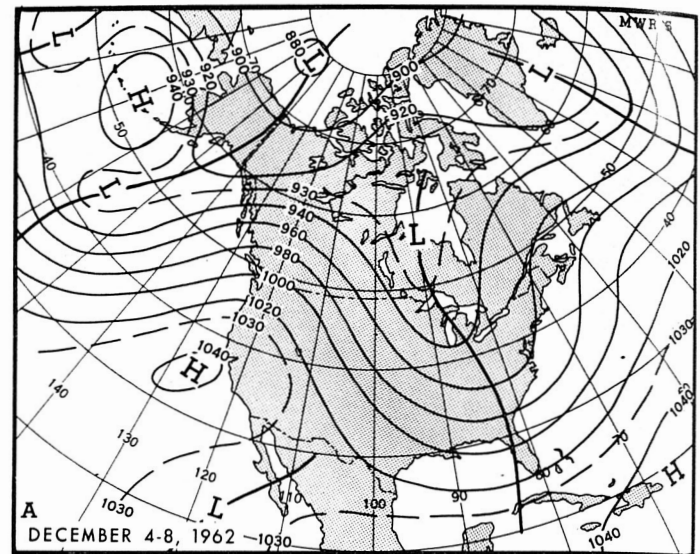


FIGURE 6.—(A) Five-day mean 700-mb. heights and (B) departures from normal, both in tens of feet, for December 4-8, 1962. (C) Departure of average temperature from normal (° F.) for week ending December 9, 1962 (from [5]). Blocking over North America dominated the weather.



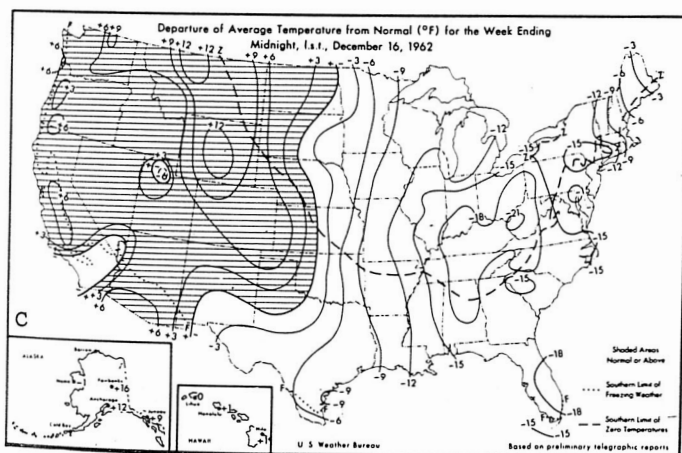
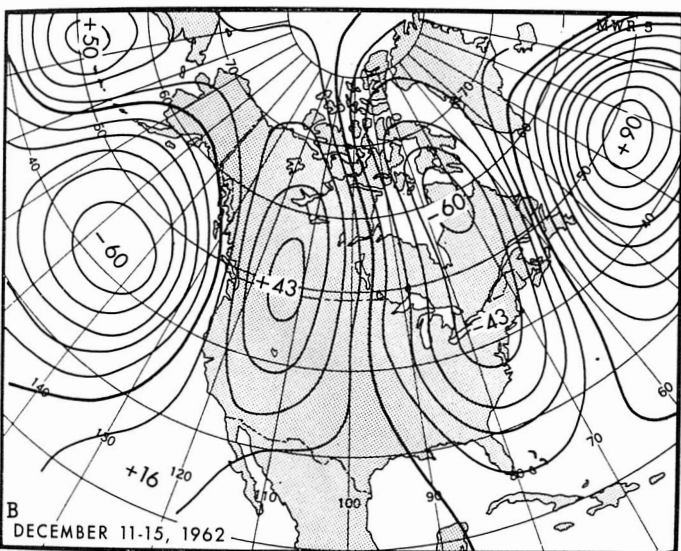
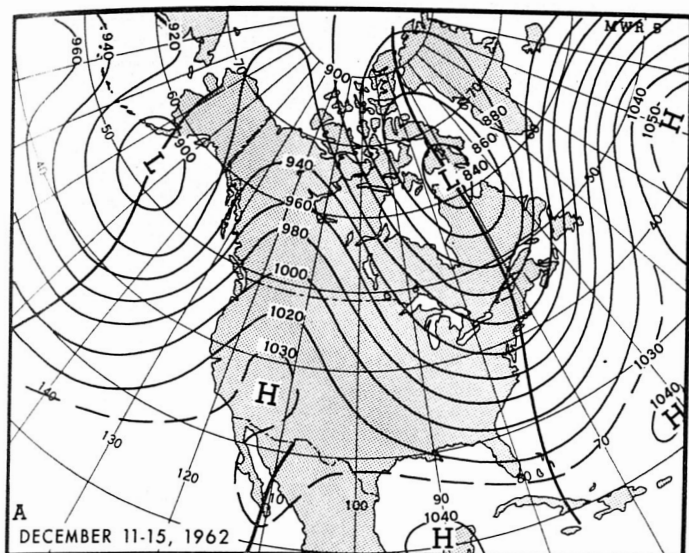


FIGURE 7.—(A) Five-day mean 700-mb. heights and (B) departures from normal, both in tens of feet, for December 11-15, 1962. (C) Departure of average temperature from normal ( $^{\circ}$  F.) for week ending December 16, 1962 (from [5]). Warmer temperatures in the West and much colder in the East were associated with amplification of the flow.

TABLE 2.—Minimum temperatures that established new all-time or monthly records in December 1962

City	Temperature ( $^{\circ}$ F.)	Type of record
<i>Alabama</i>		
Montgomery.....	5	Monthly.
<i>Florida</i>		
Pensacola.....	10	Do.
Jacksonville.....	12	Do.
Appalachicola.....	13	All-time.
Tampa.....	18	All-time.
Lakeland.....	20	Since 1915
Daytona Beach.....	21	Monthly
Fort Myers.....	26	Since 1894
West Palm Beach.....	30	All-time.
<i>Georgia</i>		
Rome.....	0	Monthly
Columbus.....	4	Do.
Macon.....	5	All-time
Augusta.....	6	Monthly
Savannah.....	9	Do.
<i>Louisiana</i>		
Baton Rouge.....	11	Monthly.
Lake Charles.....	18	Do.
<i>Mississippi</i>		
Meridian.....	4	Do.
Jackson.....	8	Do.
Vicksburg.....	9	Do.
<i>North Carolina</i>		
Asheville.....	-6	All-time.
Greensboro.....	0	Monthly.
<i>South Carolina</i>		
Greenville.....	6	Do.
<i>Tennessee</i>		
Nashville.....	-7	Do.
Chattanooga.....	-2	Do.
<i>Virginia</i>		
Richmond.....	8	Do.

tion over North America during the second week (figs. 7A and 7B). This amplification was related to relaxation of blocking over eastern North America and to the dispersion of energy from a deepening trough in the eastern Pacific. Thus the ridge in western North America strengthened and the trough in the East deepened and the circulation was highly favorable for the release of this record cold wave.

Arctic air in a migratory High moved out of Siberia and entered western Alaska on December 6. This anticyclone grew to more than 1052 mb. as it moved into the Northwest Territories on December 10 with temperatures of  $-46^{\circ}$  F. or lower at the surface. Three days later this air had advanced southward to the Gulf of Mexico in the fast northerly upper-level flow. Along this route record temperatures were established over several States in the South and Southeast. All-time minimum temperatures and new lows for December are shown in table 2, all of which occurred on December 12 or 13. New minimum daily records were numerous from Iowa southeastward. Temperatures for the week averaged  $15^{\circ}$ – $19^{\circ}$  F. below normal (fig. 7C) with freezing temperatures reaching into Dade County (Miami), Florida.

Great financial losses from this historic freeze include damage to much of the citrus crop (of which only 10 percent had been harvested prior to the freeze), tender truck

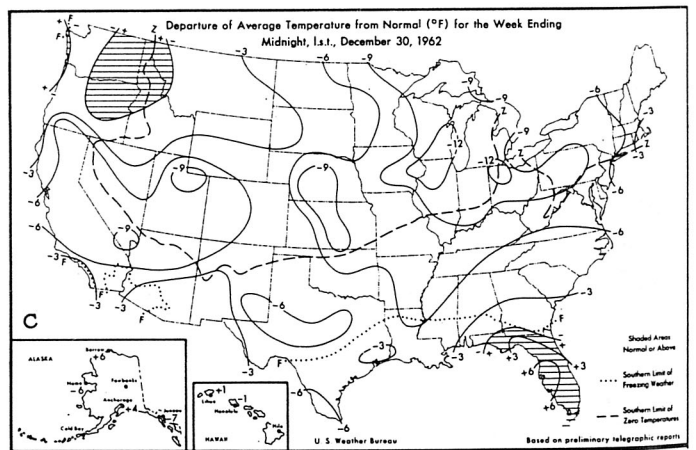
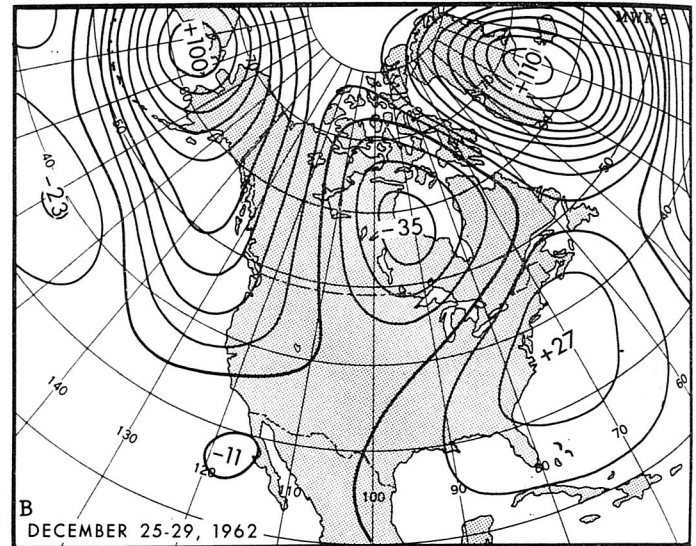
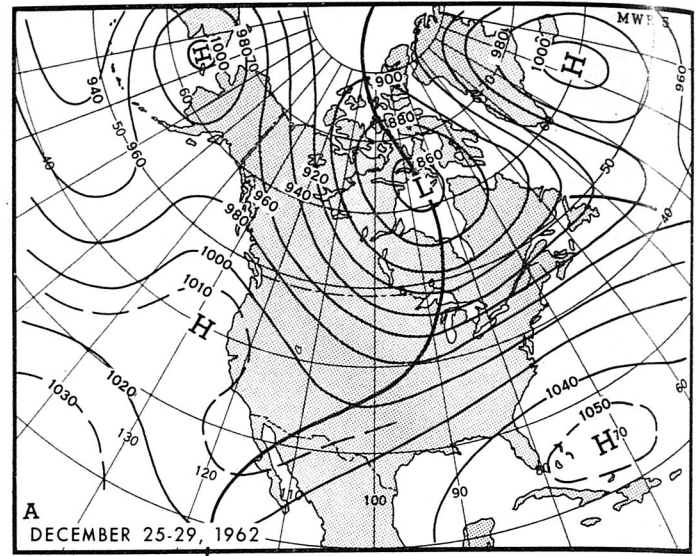
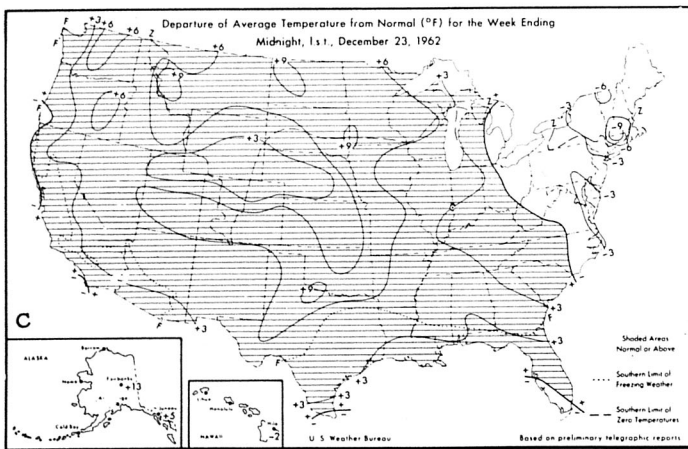
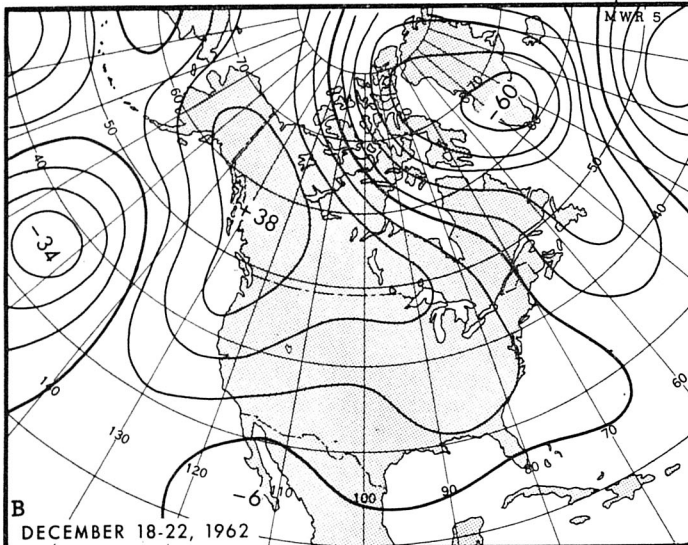
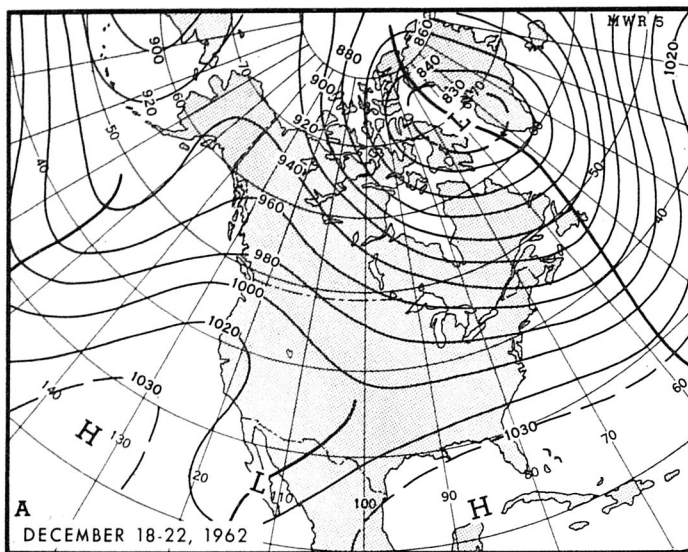


FIGURE 8.—(A) Five-day mean 700-mb. heights and (B) departures from normal, both in tens of feet, for December 18–22, 1962. (C) Departure of average temperature from normal ( $^{\circ}$  F.) for week ending December 23, 1962 (from [5]). Flattening of flow was accompanied by general warming.

FIGURE 9.—(A) Five-day mean 700-mb. heights and (B) departures from normal, both in tens of feet, for December 25–29, 1962. (C) Departure of average temperature from normal ( $^{\circ}$  F.) for week ending December 30, 1962 (from [5]). Cooling spread into the West for the first 5-day period this month as the western ridge retrograded.

produce, sugar cane, and ornamentals. Lowest temperature reported in Florida was 5° F. at De Funiak Springs in the northwestern part of the State, compared with the lowest temperature of record in Florida, -2° F. at Tallahassee in February 1899. (Note: see [2] for more details of the December 1962 freeze.) Prior to this cold wave, one of the most severe in recent years in the South was that of January 1962. In the latter instance the upper level flow (fig. 7a of [4]) steered the coldest air much farther westward.

Temperatures were above normal in the western half of the United States (fig. 7C), consistent with anticyclonic conditions and above normal heights. By the end of the week a warming westerly flow spread to the Northern Plains States. Sioux City, Iowa, warmed to 64° F. on the 16th following a minimum of -11° F. on the 12th.

An interesting sidelight concerns the zonal index and the temperature anomaly. The record cold occurred after the index reached a minimum; in fact, the index was rising rapidly at the time, an example of the well-known lag between temperature and circulation.

#### THIRD WEEK—WARMING

Decreasing amplitude in the pattern at 700 mb. occurred this week (figs. 8A and 8B) as there was apparent retrogression of the trough in the eastern Pacific and the ridge along the Rockies. In addition, the trough formerly in eastern North America progressed some 10°-15° of longitude. These changes resulted in a broad cyclonic flow of fast westerlies in middle latitudes from the Rockies to the eastern Atlantic.

Higher than normal temperature were reported in almost all sections of the United States (fig. 8C) except from the Middle Atlantic States northward. Here temperatures were mostly a few degrees lower than normal, influenced to a great extent by an Arctic High that followed a track north of the Great Lakes (see Chart VIII of [2]). Cold air made little intrusion south of the Ohio Valley and the confluent zone shown in figure 8A.

Snow, sleet, and rain fell over a broad zone from Texas to New England as perturbations on the polar front moved out of the lower Mississippi Valley toward the Middle Atlantic States. Snowfall was generally 2 in. to 8 in., with amounts to 1 ft. in West Virginia. Near the end of the week a storm deepened over the Lakes and was followed by another cold High that moved into the Central Plains, then eastward.

#### FOURTH WEEK—COLDER

Further retrogression in the West occurred during the fourth week (figs. 9A and 9B) as the western ridge moved off the west coast. Meanwhile the Atlantic trough moved eastward and weakened and a new trough formed in central North America. These changes resulted in a pronounced

cooling trend over the Nation (fig. 9C) as the anomalous height component became northerly. Polar air moved across the Rockies and into the Far West where temperatures were 6° to 9° F. lower than normal over a large area and for the first time this month the West was generally colder than normal. East of the Rockies the cold air was transported eastward and southward and reduced temperatures to 9°-12° F. below normal in central sections. Only in Florida were temperatures significantly higher than normal.

Before any appreciable warming could occur, a second cold outbreak followed cyclogenesis in the Gulf States. Another widespread snowfall accompanied this storm as it traveled eastward, deepened off the coast, and caused one of the worst blizzards in recent years in New England.

#### 4. EUROPEAN WEATHER

Injurious smog in Great Britain was a serious problem for four days early in December. In the 5-day period ending December 5, 700-mb. heights were 700 ft. above normal over the North Sea. This warm ridge, part of a blocking complex that covered much of the Atlantic and Europe, was essentially stagnant for one week, until eroded by cold air advection.

Violent rainstorms in Greece on the 18th were followed by flooding that left an estimated 12,000 persons homeless. At this time there was cyclogenesis southwest of Crete with sea level pressure below 985 mb. in the Low that formed on the trailing cold front. This front was accompanied by gusts to 117 m.p.h. the previous day in Scotland and high winds over most of northern Europe.

Also on the 18th a small High was developing over Finland. By the 20th it had grown to 1028 mb. and was partially effective in maintaining cyclonic activity in the Mediterranean as it became elongated with a strong easterly flow near 45°-50° N. Disturbances in the Mediterranean resulted in considerable overrunning and much snow. There were avalanches in the mountains of Italy and snow flurries in Rome. This was the coldest Christmas in Italy in this century as the sea level High over Sweden exceeded 1052 mb. and extended from the Urals to the eastern Atlantic.

Near the end of the month blizzard conditions were reported variously from the far north to the Mediterranean. As one storm moved into northern Europe another was developing in the Gulf of Genoa, and both contributed to widespread snow.

#### REFERENCES

1. J. F. Posey, "The Weather and Circulation of November 1962," *Monthly Weather Review*, vol. 91, No. 2, Feb. 1963, pp. 93-98.
2. U.S. Weather Bureau, *Climatological Data, National Summary*, vol. 13, No. 12, Dec. 1962, Charts VIII and IX.



3. J. Namias, "The Annual Course of Month-to-Month Persistence in Climatic Anomalies," *Bulletin of the American Meteorological Society*, vol. 33, No. 7, Sept. 1952, pp. 279-285, and an unpublished extension through 1954.
4. L. P. Stark, "The Weather and Circulation of January 1962—A Month with Large Circulation Changes and Widespread Cold," *Monthly Weather Review*, vol. 90, No. 4, Apr. 1962, pp. 167-174.
5. U.S. Weather Bureau, *Weekly Weather and Crop Bulletin, National Summary*, vol. XLIX, Nos. 50-53, Dec. 10, 17, 24, 31, 1962, and vol. L, No. 1, Jan. 7, 1963.